group and the primary chain in a molecule is cut, and a dangling bond is formed. In addition, dehydration reaction effectively occurs due to heat treatment, whereby the dangling bond is coupled with another molecule or group without being coupled with the OH group. This is considered as a reason why the insulation film formed by the process of the present embodiment has low relative dielectric constant and sufficient crack resistance property by the formation of the rigid network.

Now, a change in film structure of each of the insulation films formed by the process of the present embodiment and process A - C is discussed here.

The inventors, analyzed by FT - IR each of the insulation films formed by the process of the present embodiment, process A, and process C, and investigated a ratio of a respective one of the spectrum intensity area of Si-CH_3 bonding to the spectrum intensity area of Si-O and the sum of the spectrum intensities area of H_2 and Si-OH when the spectrum intensity area for Si-O bonding is defined as 1. The result is shown in Table 2.

Table 2

	Si-O	Si-CH_3	H_2O + Si-OH
Embodiment	1	0.03	0.00
Process A	1	0.04	0.00
Process C	1	0.02	0.52

An semiconductor device including an insulation film formed by a process according to an aspect of the present invention is generally described as bellow. That is a semiconductor device according to an aspect of the present invention comprises a substrate; and

an organic silicon oxide film provided on the substrate, wherein, when the organic silicon oxide film is analyzed by using a Fourier transform infrared-ray spectroscopy, a ratio of a spectrum intensity area for $Si-CH_3$ bonding to a spectrum intensity area for Si-O bonding is from 0.01 to 0.03, and a ratio of a spectrum intensity area for H_2O and Si-OH bonding to a spectrum intensity area for Si-O bonding is not higher than 0.001, respectively.

More specifically, relative dielectric constant of the insulation film is not higher than 3.5, and a crack resistance film thickness of the insulation film is not less than 1.5 microns. The organic silicon oxide film is a polymethylsiloxane film. And further comprises a wire whose main material is Cu and which is embedded on a surface of the insulation film.

The electron beam irradiation dose or the like is increased in order to further accelerate bridge reaction, the spectrum intensity of $Si-CH_3$ bonding further decreases, and a mere silicon oxide film is produced. Thus, if bridge reaction is further accelerated, even if crack resistance property is

sufficient, there is a possibility that the insulation film with a low relative dielectric constant is not obtained. According to experiments made by the inventors, it is found that the spectrum intensity area ratio of $Si-CH_3$ bonding must be at least 0.01.

In this way, as in the present embodiment, the process B and the process C are well combined with each other, whereby molecule chain cutting and bridge, and dehydrate condensation are effectively carried out. As a result, there can be provided an insulation film with high mechanical strength and low relative dielectric constant.

According to researches made by the inventors, with respect to the sum of number of scratches and cracks caused by CMP process, the insulation film formed by the process of the present embodiment is reduced by 1/10 times as compared with that formed by the process A.

In addition, with respect to thickness of a damage layer formed by dry etching and dry ashing as well, the insulation film formed by the process of the present embodiment is found to have been reduced by about 30% as compared with that formed by the process A.

In the present embodiment, the pressure and the irradiation quantity are changed, the insulation film with high mechanical strength and low relative dielectric constant can be obtained by changing one of